

4.5 PSP Cover Sheet (Attach to the front of each proposal)

Fish Treadmill-Developed Fish Screen Criteria for Native
 Proposal Title: Sacramento-San Joaquin Watershed Fishes
 Applicant Name: Joseph J. Cech, Jr.
 Mailing Address: Wildlife, Fish, & Conservation Biology, University of Califor
 Telephone: (530) 752-3103 Davis, CA 95616
 Fax: (530) 752-4154
 Email: jcech@ucdavis.edu

Amount of funding requested: \$ 1,036,821 for 13.5 ~~years~~ months

Indicate the Topic for which you are applying (check only one box).

- | | |
|---|---|
| <input checked="" type="checkbox"/> Fish Passage/Fish Screens | <input type="checkbox"/> Introduced Species |
| <input type="checkbox"/> Habitat Restoration | <input type="checkbox"/> Fish Management/Hatchery |
| <input type="checkbox"/> Local Watershed Stewardship | <input type="checkbox"/> Environmental Education |
| <input type="checkbox"/> Water Quality | |

Does the proposal address a specified Focused Action? xx yes no

What county or counties is the project located in? Yolo

Indicate the geographic area of your proposal (check only one box):

- | | |
|--|--|
| <input type="checkbox"/> Sacramento River Mainstem | <input type="checkbox"/> East Side Trib: <u> </u> |
| <input type="checkbox"/> Sacramento Trib: <u> </u> | <input type="checkbox"/> Suisun Marsh and Bay |
| <input type="checkbox"/> San Joaquin River Mainstem | <input type="checkbox"/> North Bay/South Bay: <u> </u> |
| <input type="checkbox"/> San Joaquin Trib: <u> </u> | <input checked="" type="checkbox"/> Landscape (entire Bay-Delta watershed) |
| <input type="checkbox"/> Delta: <u> </u> | <input type="checkbox"/> Other: <u> </u> |

Indicate the primary species which the proposal addresses (check all that apply):

- | | |
|--|---|
| <input type="checkbox"/> San Joaquin and East-side Delta tributaries fall-run chinook salmon | <input type="checkbox"/> Spring-run chinook salmon |
| <input type="checkbox"/> Winter-run chinook salmon | <input type="checkbox"/> Fall-run chinook salmon |
| <input type="checkbox"/> Late-fall run chinook salmon | <input type="checkbox"/> Longfin smelt |
| <input checked="" type="checkbox"/> Delta smelt | <input checked="" type="checkbox"/> Steelhead trout |
| <input checked="" type="checkbox"/> Splittail | <input type="checkbox"/> Striped bass |
| <input type="checkbox"/> Green sturgeon | <input checked="" type="checkbox"/> All chinook species |
| <input type="checkbox"/> Migratory birds | <input type="checkbox"/> All anadromous salmonids |
| <input type="checkbox"/> Other: <u> </u> | |

Specify the ERP strategic objective and target (s) that the project addresses. Include page numbers from January 1999 version of ERP Volume I and II:

Vol. 2, p. 428-429, Vol. 1, p. 110

Indicate the type of applicant (check only one box):

- | | |
|--|---|
| <input type="checkbox"/> State agency | <input type="checkbox"/> Federal agency |
| <input type="checkbox"/> Public/Non-profit joint venture | <input type="checkbox"/> Non-profit |
| <input type="checkbox"/> Local government/district | <input type="checkbox"/> Private party |
| <input checked="" type="checkbox"/> University | <input type="checkbox"/> Other: _____ |

Indicate the type of project (check only one box):

- | | |
|--|---|
| <input type="checkbox"/> Planning | <input type="checkbox"/> Implementation |
| <input type="checkbox"/> Monitoring | <input type="checkbox"/> Education |
| <input checked="" type="checkbox"/> Research | |

By signing below, the applicant declares the following:

- 1.) The truthfulness of all representations in their proposal;
- 2.) The individual signing the form is entitled to submit the application on behalf of the applicant (if the applicant is an entity or organization); and
- 3.) The person submitting the application has read and understood the conflict of interest and confidentiality discussion in the PSP (Section 2.4) and waives any and all rights to privacy and confidentiality of the proposal on behalf of the applicant, to the extent as provided in the Section.

Joseph J. Cech, Jr.

Printed name of applicant

Joseph J. Cech, Jr.

Signature of applicant



smowdy@ucdavis.edu
OFFICE OF THE VICE CHANCELLOR FOR RESEARCH
(530) 752-2075
FAX: (530) 752-5432

410 Mrak Hall, One Shields Avenue
DAVIS, CALIFORNIA 95616-8671

April 14, 1999

CALFED Bay-Delta Program Office
1416 Ninth Street, Suite 1155
Sacramento, CA 95814

Proposal Title: "Fish Treadmill-Developed Fish Screen Criteria for Native
Sacramento-San Joaquin Watershed Fishes"
Principal Investigator – Joseph J. Cech, Jr.

Dear Colleague:

It is a pleasure to present for your consideration the referenced proposal.

It is our understanding that for purposes of determining applicant category, The Regents will be classified as "State" thereby resulting awards will only include the terms identified in Attachment D of the 1999 Proposal Solicitation Package as "Terms and Conditions for State (CALFED) Funds" and "Standard Clauses-Interagency Agreements".

The University takes exception to clauses pertaining to Substitution, Rights in Data and Indemnification as detailed in Attachment D. On behalf of The Regents of the University of California, we hereby reserve the right to negotiate said clauses as detailed in the Proposal Solicitation Package should this proposal result in a subsequent award.

Please call on the principal investigator for scientific information. Administrative questions may be directed to me or to Petrina Ho by telephone, facsimile or electronic mail at the numbers specified above. We request that correspondence pertaining to this proposal and a subsequent award be sent to the Office of Research and to the principal investigator.

Sincerely,

A handwritten signature in cursive script that reads "Sandra M. Dowdy".
Sandra M. Dowdy
Contracts & Grants Analyst

Enclosures

Proposal to:

Name CALFED Bay-Delta Program Office
Address 1416 Ninth Street, Suite 1155
Sacramento, CA 95814

Submitting Organization:

THE REGENTS OF THE UNIVERSITY OF CALIFORNIA
UNIVERSITY OF CALIFORNIA
ONE SHIELDS AVENUE
DAVIS, CALIFORNIA 95616

Title of Proposed Research: Fish Treadmill-Developed Fish Screen Criteria for Native
Sacramento-San Joaquin Watershed Fishes

Total Amount Requested:

\$823,000 / \$1,036,821

Proposed Duration:

13.5 months

Desired Starting Date:

8-16-99

Principal Investigator/

Co-Investigator(s):

Joseph J. Cech, Jr.
M. Levent Kavvas
Robert Fujimura

Department:

Wildlife, Fish, & Cons. Biology
Civil & Environ. Engineering
Cal. Dept. Fish & Game

Phone Number:

(530) 752-3103
(530) 752-2518
(209) 948-7097

Checks Made Payable to:

The Regents of the University of California

Send Checks to:

CASHIER'S OFFICE
UNIVERSITY OF CALIFORNIA
ONE SHIELDS AVENUE
DAVIS, CA 95616

Send Award Notice to:

OFFICE OF RESEARCH
UNIVERSITY OF CALIFORNIA
ONE SHIELDS AVENUE
DAVIS, CA 95616
(530) 752-2075

Approvals:

Joseph J. Cech, Jr. 4-13-99

Principal Investigator

Date

Co-Investigator

Date

Co-Investigator

Date

Department Chair

Date

Dean, College/School

Date

Keith Yauer 4/15/99
Official Signing for Organization

PD:/kirkman.frm/proposal

I. TITLE PAGE

Title of Project: FISH TREADMILL-DEVELOPED FISH SCREEN CRITERIA FOR
NATIVE SACRAMENTO-SAN JOAQUIN WATERSHED FISHES

Principal Investigator: Joseph J. Cech, Jr.
Department of Wildlife, Fish, and Conservation Biology
University of California, Davis
(530) 752-3103, FAX (530) 752-4154, email: jjcech@ucdavis.edu

Co-Principal Investigator: M. Levent Kavvas
Department of Civil and Environmental Engineering
University of California, Davis

Type of Organization and Tax Status: State assisted public research and
educational institution

Tax Identification Number: 94-603-6494

FISH TREADMILL-DEVELOPED FISH SCREEN CRITERIA FOR NATIVE SACRAMENTO-SAN JOAQUIN WATERSHED FISHES

II. EXECUTIVE SUMMARY

The Fish Treadmill Project is an ongoing, multi-agency research effort to quantitatively evaluate the performance and behavior of small Delta and upstream fishes in multi-vector flows near fish screens for the purpose of developing fish screen design, flow, and operational criteria that reduce adverse impacts of water diversions on these species. This proposal requests funding from CALFED to continue the project for a period of 13.5 months (August 16, 1999-September 30, 2000) in order to complete ongoing experiments with delta smelt, splittail and chinook salmon, and to conduct experiments with steelhead trout and other priority species.

Installation of fish screens and improvements to existing fish screen facilities have been identified by CALFED as activities that provide direct benefits to fish resources, habitats, and ecosystem processes by reducing stressors associated with water diversions (ERPP, Vol. 1, p. 425). However, present fish screen criteria are based on limited data from (usually) unrealistic flume studies with salmonids and non-native fishes (e.g., the delta smelt criterion is based on data from American shad). For many native fishes of the Sacramento-San Joaquin system, including listed species like delta smelt and splittail, these criteria may be inadequate and confer no protection from entrainment and impingement, or overly protective and thus unnecessarily costly to water diverters. The Fish Treadmill project was specifically proposed and designed by cooperative, multi-agency partners to address these information gaps for priority native fishes and to provide timely, relevant, and comprehensive data that could be applied to design, operate, and adaptively manage screened water diversions that more effectively protect Sacramento-San Joaquin watershed fish resources.

The Fish Treadmill is a large circular flume equipped with a fish screen, uniquely capable of testing small, delicate fishes like delta smelt in a wide range of independently controlled approach and sweeping velocities. The apparatus is operational, calibrated for a wide range of flows, and staffed with highly qualified personnel. The biological study plan and quality control/assurance plan, developed through rigorous multi-agency discussion, review and pilot studies, have been approved by the existing contract Quality Assurance Officer (K. Bates, consultant to DWR) and members of the quarterly review panel (DWR, DFG, NMFS, USFWS). Unlike field-based studies at large fish screen facilities (e.g., Tracy Fish Facility), the Fish Treadmill allows detailed, quantitative observations on fish performance (e.g., impingement, survival, injury, stress) and behavior (e.g., swimming velocity, velocity past screen) under controlled flow and environmental (e.g., temperature) conditions during the day (light conditions) and night (dark conditions). For each species, results of experiments will be applied to determine optimal screen flow conditions that minimize impingement, screen exposure duration, and mortality. Comparisons among and between species, size classes, environmental conditions, and time of day will provide data for development of adaptive management strategies for screened water diversions.

The Fish Treadmill project is ongoing and presently funded exclusively by DWR. To date (1.5 years into a planned three-year biological study program), experiments have been conducted with delta smelt (approximately 40% complete), splittail (approximately 80% complete), and chinook salmon (approximately 70% complete). This proposal requests funding from CALFED

for the remainder of the planned research program in order to complete these experiments and to conduct experiments with steelhead trout and other priority species. The Fish Treadmill project should be funded by CALFED for several reasons. It addresses a major stressor, water diversions, and is specifically designed to produce the scientific information necessary for CALFED to reduce the adverse impacts of the stressor by installation of protective fish screens. Results of this project will provide benefit to 11 of the 14 Ecological Management Zones defined by CALFED (most located in the Bay/Delta and mainstem rivers) and to virtually all of the highest priority fish species (delta smelt, splittail, chinook salmon, steelhead trout). For example, in the Sacramento-San Joaquin Delta Ecological Management Zone, reduction of entrainment and impingement losses of fish at water diversions is identified as a target, with replacement/upgrades of the SWP, CVP, and PG&E screens identified as specific programmatic actions (ERPP, Vol. 2, p. 110). For protection of fishes like delta smelt and splittail, results of the Fish Treadmill project will be very useful in developing design and operational criteria for these new/upgraded fish screens. By developing the data and technology to reduce water diversion impacts, the project has links to other ecosystem elements and CALFED goals, including native species recovery and conservation (CALFED Goal 1), improving recreational and commercial fisheries (CALFED Goal 3), and rehabilitation and protection of natural processes (CALFED Goal 2), successful implementation of the CVPIA and of recovery measures for ESA listed species, and non-ecosystem benefits like water supply reliability. Continuation and completion of the Fish Treadmill project has multi-agency support, including CALFED (ERPP, Vol. 1, p. 428-429), DWR, DFG, USBR, NMFS, and USFWS.

CALFED funding is requested to support the operation of the Fish Treadmill (UCD Hydraulics Laboratory), implementation of the biological studies (UCD Fish Physiology Group), and DFG assistance for fish collection and participation in the experiments. DWR has agreed to share costs by providing funding to support one scientific aide for assistance with the biological studies. Cost of the project depends on funding source: \$823,000 if funded through a State agency and \$1,036,821 if funded through a federal agency. There are no adverse or third party impacts of this project.

The principal investigator, Dr. Joseph J. Cech, Jr., is presently the co-principal investigator for the ongoing Fish Treadmill biological studies. All other staff, including co-principal investigator Dr. M. L. Kavvas (supervisor for Fish Treadmill operation and hydraulic studies), and co-investigators Drs. Christina Swanson and Paciencia S. Young (managing biologists for the Fish Treadmill biological studies), Dr. Z. Q. Chen (managing engineer for Fish Treadmill operation and hydraulic studies), and Robert Fujimura (DFG, interagency liaison and fish collection supervisor) participated in the development of the Fish Treadmill project and are presently actively involved in the program.

III. PROJECT DESCRIPTION

A. Proposed Scope of Work

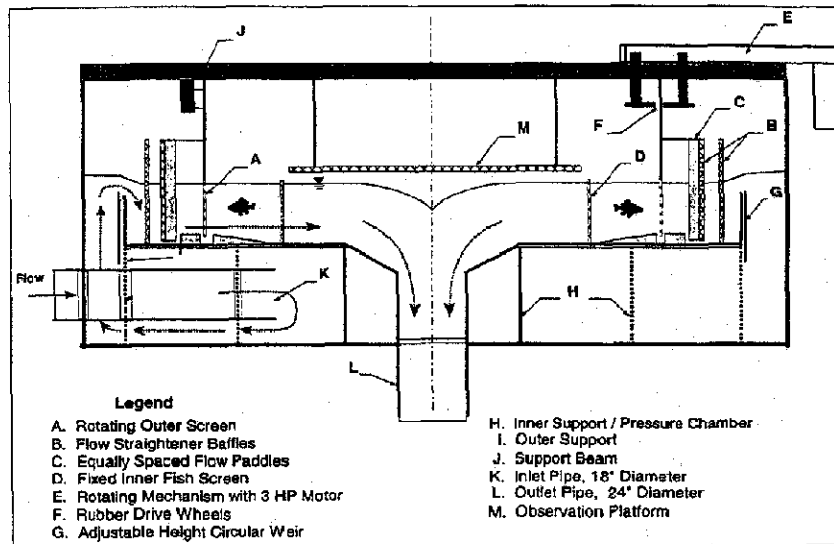
1. Introduction

The Fish Treadmill Project is an ongoing, multi-agency research effort to quantitatively evaluate the performance and behavior of small Delta and upstream fishes in multi-vector flows near fish screens for the purpose of developing fish screen design and operational criteria that improve fish protection and passage. This proposal requests funding from CALFED to continue the project for a period of 13.5 months (August 16, 1999-September 30, 2000) in order to complete ongoing experiments with delta smelt, splittail and chinook salmon, and to conduct experiments with steelhead trout and other priority species.

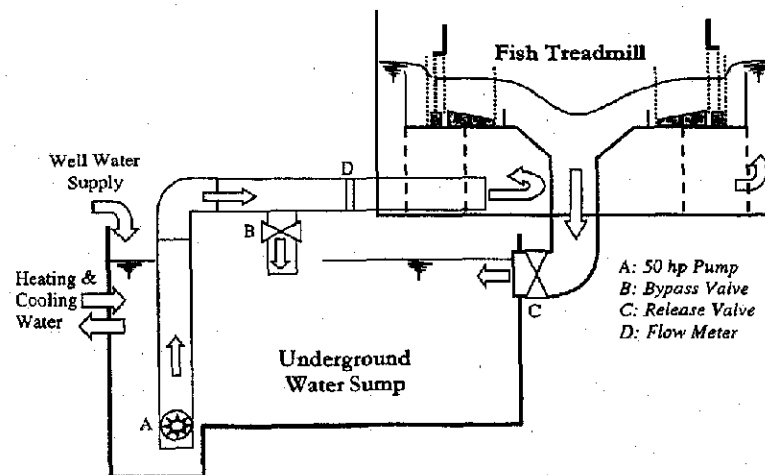
2. Background

In the late 1970s, California Department of Fish and Game conducted pioneering studies to investigate the performance of small fishes exposed to two-vector flows (i.e., an approach flow through the screen and a sweeping flow past the screen) near a positive barrier fish screen (Kano, 1982). The intended application of the results was to aid in the design of on-river fish screens for the proposed Peripheral Canal. The test flume, study design and implementation, and results obtained were limited in scope. Only a narrow range of approach and sweeping flow combinations was tested (range: 0.1-0.35 ft/s approach velocity, 0.16-0.95 ft/s sweeping velocity). All tested fishes except chinook salmon were non-native (e.g., American shad, striped bass), and post-exposure survival was the only response measured. No data on fish performance (e.g., impingement) or behavior (e.g., swimming behavior, screen passage velocity) were collected during the 6-hour test exposure periods. However, it is the results of these studies that were the bases for the present approach velocity criteria for chinook salmon (0.33 ft/s) and delta smelt (0.2 ft/s).

Recognizing the need for more comprehensive understanding of fish responses to fish screens, specific information on endangered native fishes, and the ability to address difficult questions relating to screen design and operation (e.g., ratio of approach to sweeping flow, distance between bypass channels), the Interagency Ecological Program Fish Facilities Technical Committee proposed the Fish Treadmill project. In 1994, California Department of Water Resources contracted with the University of California, Davis (UCD), Hydraulics Laboratory to design and construct the Fish Treadmill, a large circular flume (Figure 1) in which complex flow conditions (Figure 2) similar to those near screened water diversions could be created, controlled, and monitored (Principal Investigator: M. L. Kavvas, Department of Civil and Environmental Engineering). During the design, construction, and calibration phases, extensive discussions with biologists and engineers from state and federal agencies (DFG, DWR, NMFS, USFWS, USBR), UCD, outside consultants, and other interested parties (e.g., Metropolitan Water District) formulated the biological studies to be conducted with the Fish Treadmill, including experimental design, fish species, methods and measurements, and quality control and assurance protocols. In October 1997, biological studies with delta smelt, splittail (young-of-the-year), and chinook salmon (parr and smolts) were begun by the UCD Fish Physiology Group (Principal Investigator: Joseph J. Cech, Jr., Department of Wildlife, Fish, and Conservation Biology) with extensive cooperation from DFG and DWR. By the completion of the present contract (DWR contract B-81622, end date: August 15, 1999), experiments with splittail and chinook salmon will be nearly complete but those with delta smelt, a priority species considered highly vulnerable to water diversions, will be less than half done. Other priority species, such as steelhead and longfin smelt, remain to be tested.

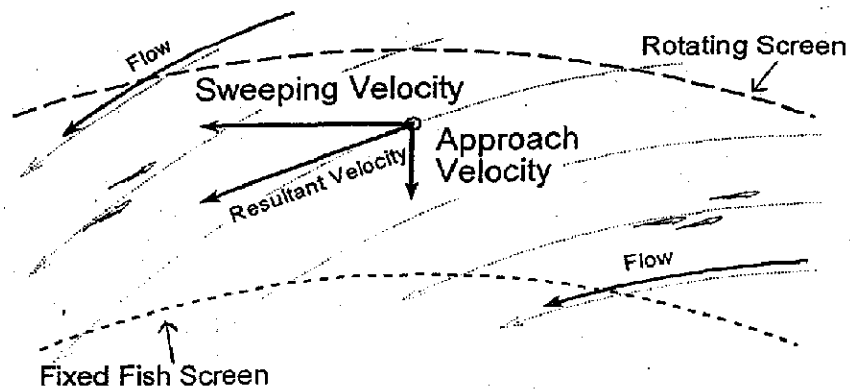


Cross section of the Fish Treadmill Apparatus

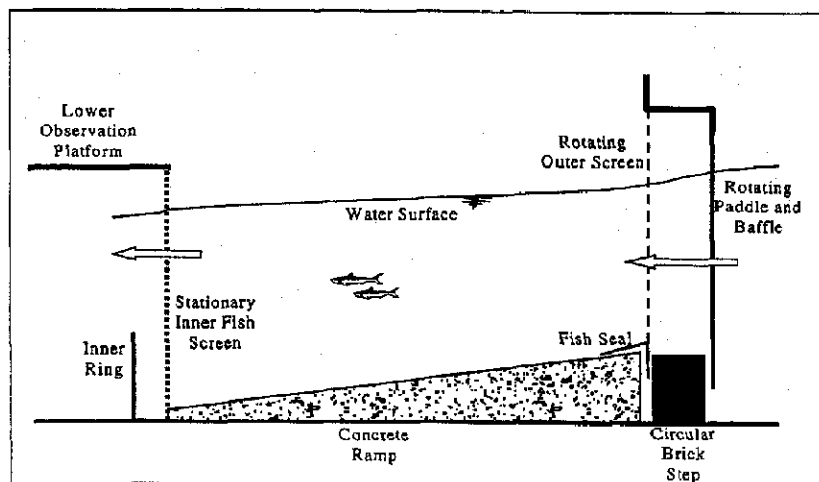


Water Circulation in the Fish Treadmill Facility

Figure 1. Diagrams of the Fish Treadmill apparatus.



Top view of the Fish Treadmill swimming channel showing the approach and sweeping velocity flow vectors.



Close-up view of the final swimming channel cross-section

Figure 2. Top view and side view diagrams of the Fish Treadmill swimming channel. Top view diagram shows the approach, sweeping, and resultant flow vectors controlled in the channel.

3. Objectives and Approach

Objective 1: Quantitatively evaluate performance and behavior of small-size priority fishes (delta smelt, splittail, chinook salmon, steelhead trout) exposed to controlled multi-vector flows near a fish screen.

Approach: Expose fishes to ten different approach and sweeping flow combinations (0-0.5 ft/s approach velocity, 0-2.0 ft/s sweeping velocity; nine experimental flow regimes and a control, 0 ft/s) and a fish screen (3/32 inch vertical wedgewire) in the Fish Treadmill. Measure screen contact, impingement, swimming velocity, rheotaxis, location relative to screen, screen passage velocity, and survival throughout the exposure period. Measure survival, injury (e.g., scale loss, fin damage), and stress (e.g., plasma cortisol levels) after the exposure period.

Objective 2: Quantitatively evaluate the effects of species, season, time of day and light level, and fish size on fish performance and behavior in these multi-vector flows near the fish screen.

Approach: Compare fish performance and behavior (defined above) at the different flow regimes among and between species at different seasonal temperatures (i.e., spring/winter vs summer/fall, 12°C vs 19°C), times of day and light levels (i.e., day under light conditions vs night under dark conditions), and of different sizes (3-6 cm and >6 cm standard length, SL).

Objective 3: In collaboration with state and federal agencies, suggest refinements for present fish screen design, flow, and operational criteria to improve protection of priority species.

Approach: For each of the tested species apply results to:

- determine optimal **approach velocities** for fish protection and water diversion.
- determine optimal **sweeping velocities** that maximize fish protection and screen passage.
- determine **screen passage velocities** and maximum allowable **screen exposure durations**.
- determine the effects of season (i.e., temperature, fish size) and time of day (i.e., day vs night) on fish performance and behavior near fish screens to develop **adaptive management** strategies for screened water diversions.

Biological studies with the Fish Treadmill are ongoing and the experimental approach, design, methods, and analyses have already been subjected to rigorous discussion and review. Descriptions of the work and preliminary results for delta smelt, splittail, and chinook salmon have been reported in several technical reports (Velagic et al., 1998; Swanson et al. 1998a), IEP Newsletter articles, and presentations at technical and scientific meetings. Detailed descriptions of all aspects of the project are provided in the Fish Treadmill Quality Assurance Project Plan (Swanson et al. 1998b).

4. Proposed Work and Schedule

The proposed work and schedule outlined below are based on successful completion of an average of 4.5 experiments/week (this experiment rate is consistent with that achieved during the past 1.5 years of work with the Fish Treadmill) and contingent on adequate funding, personnel, and fish availability. Three tasks are identified (see VIII. Cost, for specific activities involved in these tasks):

- Task 1. Operation, maintenance, and calibration of the Fish Treadmill;
- Task 2. Biological experiments using the Fish Treadmill; and
- Task 3. Fish Collection.

The schedule of experiments for each species is determined by species priority rank, seasonal availability (most species are available in the appropriate sizes during limited seasonal periods), and the numbers and types of experiments required to complete experimental datasets defined in the Fish Treadmill experimental design and project plan. Preliminary data analysis is conducted concurrently with the experiments. Final data analyses and preparation of the final report will be completed by November 1, 2000. Project management will be conducted by the Principal Investigator, J. J. Cech, Jr. (UCD, Biological studies), and co-investigators M. L. Kavvas (UCD, Fish Treadmill operation) and R. Fujimura (DFG, liaison and field fish collection).

Delta smelt: Complete ongoing experiments in 12 and 19°C, day and night, 80-100 experiments, requires 2000 live fish, August 1999-February 2000.

Steelhead trout: Conduct experiments with parr, 3-5 cm SL, 12°C, day and night experiments, 60 experiments, February 2000-June 2000.

Splittail: Complete ongoing experiments in 12 and 19°C, day and night, 40 experiments, August 1999-June 2000.

Chinook salmon: Complete ongoing experiments, 19°C, day and night, 20-60 experiments (depending on number of experiments completed in 1999), June 2000-July 2000.

Longfin smelt, American shad, striped bass: Conduct experiments with young-of-the-year fish, 19°C, as time and fish availability permit.

B. Location and Geographic Boundaries

The stressors, habitats, and species addressed by this project are located in 11 of the 14 Sacramento-San Joaquin watershed Ecological Management Zones identified by CALFED to contain screened and unscreened water diversions, proposed new water diversions (e.g., for new off-stream storage, Sacramento River), and/or existing water diversions for which new or upgraded fish screens are proposed (e.g., Clifton Court Forebay at the SWP, Tracy Fish Facility at the CVP) (ERPP, Vol. 1, p 424). The quantitative data generated by this laboratory-based project will be immediately applicable and complementary to ongoing and proposed field evaluations of large screened diversions (e.g., Tracy Fish Facility Improvement Program, Glenn-Colusa Irrigation District, GCID, screen evaluation program). In addition, the results of this project will be broadly applicable to IEP agency and CALFED decision makers to assess and predict the beneficial effects of various screening strategies for proposed CALFED alternatives.

IV. ECOLOGICAL/BIOLOGICAL BENEFITS AND TECHNICAL JUSTIFICATION

A. Ecological/Biological Objectives

Installation of fish screens and improvements to existing fish screen facilities have been identified by CALFED as activities that provide direct benefits to fish resources and the ecosystem by reducing stressors associated with water diversions. The Ecosystem Restoration Program Plan (ERPP, Vol. 1, p. 425) contends that a "well-designed fish screen based on proven technology is effective in reducing entrainment and impingement losses of many species of juvenile fish". **For most native fishes of the Sacramento-San Joaquin system, there is no "proven technology"**. Most existing and planned fish screens have been designed and operated to meet screen flow and exposure duration criteria based on limited data from (usually) unrealistic flume studies with salmonids and non-native fishes (e.g., the delta smelt criterion is based on data from American shad). For many native species, including listed species like delta smelt and splittail, these criteria may be inadequate and confer no protection from entrainment and impingement, or overly protective and thus unnecessarily costly to water diverters. The Fish Treadmill project was specifically proposed and designed by cooperative, multi-agency partners to address these information gaps for priority native fishes (e.g., delta smelt, splittail, steelhead trout, chinook salmon) and to provide timely, relevant, and comprehensive data that could be applied to design, operate, and adaptively manage screened water diversions that more effectively protect Sacramento-San Joaquin watershed fish resources.

The primary ecological/biological objective and benefit of the Fish Treadmill project is to provide the data necessary to develop the "proven technology" for protective positive barrier fish screens for priority native fishes in the Sacramento-San Joaquin watershed. These data will be useful to establish or refine fish screen design criteria (e.g., distance between possible fish bypass channels), flow criteria (e.g., approach and sweeping velocities), and operational criteria (e.g., differential or adaptive operation for different species, seasons, or day vs night). Secondary objectives and benefits include: providing complementary data for ongoing and planned fish screen evaluations at the full-scale fish screen facilities (e.g., Tracy Fish Facility, GCID); providing baseline data, an experimental approach, and an experimental platform for further studies, for example, evaluations of the effects of debris and/or screen cleaning methods on fish performance and behavior.

The experimental approach and use of this laboratory-based system for biological evaluation of fish responses to complex flows near a fish screen will provide greater direct benefit than field or other flume studies for several reasons.

1. The Fish Treadmill is uniquely capable of testing fish under a wide range of approach and sweeping flow combinations (e.g., high approach velocity combined with low sweeping velocity or low approach velocity combined with high sweeping velocity) and thus provides opportunities for detailed examinations of the interactive effects of multiple flow vectors. For example, preliminary results with delta smelt have suggested that both flow vectors significantly affect protection (e.g., survival) and passage (i.e., velocity past screen and thus exposure duration).

2. Detailed observations of fish behavior (e.g., frequency of contact with the screen, swimming behavior, velocity past screen) provide valuable information on important aspects of fish performance and behavior near fish screens, particularly when correlated with complementary data in survival, injury and stress. Observations of fishes near fish screens installed at water diversions in the Delta (e.g., Tracy Fish Facility) or on rivers (e.g., GCID) are logistically and

technically difficult because turbid water conditions limit visibility for human or video observations. Further, artificial introduction and post-exposure collection of test fish at a field and/or large-scale diversion (e.g., Tracy Fish Facility) is difficult and probably more stressful to the fish, especially at night. Thus, the effects of exposure to the flow and screen cannot be easily separated from the stressful effects of field handling.

3. Flow and environmental conditions (e.g., temperature, light levels) can be precisely controlled and reproduced in the Fish Treadmill, enabling the replication of experimental treatments necessary for statistical analyses to isolate and detect significant effects of specific factors. Environmental conditions in the field or at large facilities are inherently uncontrolled and variable, and cannot be replicated.

4. The Fish Treadmill is the **only** large scale fish screen test facility capable of testing delicate, high priority native species (e.g., delta smelt) under realistic, controlled flow and environmental conditions, and providing detailed quantitative data for the development of fish screen criteria. It is presently fully operational, calibrated for a wide range of flow conditions, and staffed with qualified, trained personnel.

B. Linkages

The Fish Treadmill project is an ongoing program, currently supported by DWR (contracts B-58719 and B-80898, 1994-1998, for Fish Treadmill final design, construction, and preliminary biological studies; and B-81622, 1998-1999, for continuation of the biological studies; results of these early Fish Treadmill studies are reported in Velagic et al., 1998, and Swanson et al., 1998). The project builds upon work by DFG using a smaller circular flume with a fish screen (Kano 1982) and upon which present fish screen flow criteria are based. The design of the biological studies using the Fish Treadmill was also based on results of previous work by the UCD Fish Physiology Group on environmental biology and behavior of native Delta and upstream fishes (e.g., delta smelt, Swanson and Cech, 1995, Swanson et al. 1996, 1998a and c; splittail, Young and Cech, 1996; chinook salmon, Young et al. 1998). This work was also supported by DWR and IEP contracts. The Fish Treadmill project directly complements and expands upon other proposed and ongoing fish screen studies at operational water diversions (e.g., GCID, and Red Bluff Diversion Dam, RBDD) and the Tracy Fish Facility.

The Fish Treadmill biological studies were originally designed with a three-year study schedule and an emphasis on native Delta fishes (delta smelt, splittail, chinook salmon) and American shad (to produce data more directly comparable to Kano, 1982). By the end of the present contract, 1.8 years of the biological studies will have been completed. During this period, concern for native Delta fishes has remained high and, because of proposed large upstream fish screen facilities (e.g., off-stream storage, Sacramento river) and upgrades to existing facilities (e.g., GCID), interest for threatened upstream species like steelhead trout has increased. Therefore, the focus of the Fish Treadmill project during the final 13.5 month has been shifted to include studies with these (and other) species.

The Fish Treadmill project addresses a major stressor, water diversions, and is specifically designed to produce the scientific information necessary for CALFED to reduce the adverse impacts of the stressor by installation of protective fish screens. Results of this project will provide benefit to 11 of the 14 Ecological Management Zones defined by CALFED (most located in the Bay/Delta and mainstem rivers) and to virtually all of the highest priority fish species (delta smelt, splittail, chinook salmon, steelhead trout). For example, in the Sacramento-San Joaquin Delta Ecological Management Zone, reduction of entrainment and impingement losses of fish at

water diversions is identified as a target, with replacement/upgrades of the SWP, CVP, and PG&E screens identified as specific programmatic actions (ERPP, Vol. 2, p. 110). For protection of fishes like delta smelt and splittail, results of the Fish Treadmill project are essential to develop the design and operational criteria for these new/upgraded fish screens.

Support for continuation of the Fish Treadmill project and its scientific evaluation of fish performance and behavior near fish screens is identified by CALFED as an activity that will help it achieve its strategic objective of reducing entrainment of fish at water diversions in order to increase fish survival and population abundances to levels that contribute to the overall health of the Delta and other beneficial uses of land and water (ERPP, Vol. 1, p. 428-429). By developing the data and technology to reduce water diversion impacts, the project has links to other ecosystem elements and CALFED goals, including:

- **native species recovery and conservation**, with an emphasis on listed species like delta smelt, splittail, chinook salmon, and steelhead trout (CALFED Goal 1);
- improving **recreational and commercial fisheries** (e.g., chinook salmon, steelhead trout) (CALFED Goal 3);
- improving Bay/Delta food webs (**rehabilitation and protection of natural processes**, CALFED Goal 2);
- successful implementation of the CVPIA (e.g., fish doubling goals); and
- successful implementation of recovery measures for listed species (**state and federal ESA**).

The Fish Treadmill project also addresses at least two other Stage 1 expectations (ERPP, Vol. 1, p 428-429), continued research on fish screen and related facilities design, and coordinating research and testing various screen programs. In addition, the Proposed Fish Facility Technology Development Interagency Technical Forum (members include representatives from CALFED, DWR, DFG, USBR, NMFS, and USFWS), in discussion of new technology requirements for Delta fish facilities, agreed that technology development should include cooperative research with UCD and the Fish Treadmill project, especially for refined programs for studying criteria with sensitive species such as delta smelt.

C. System-wide Ecosystem Benefits

Results of the Fish Treadmill project, when applied to improve fish screen design and operation and thus reduce the adverse impacts of water diversions, will have broad, system-wide ecosystem benefits, affecting

- **habitats** (e.g., both Delta and upstream habitats, including tidal perennial aquatic habitat, instream aquatic habitat, and shaded riverine habitat);
- **species**, with an emphasis on priority, listed native species like delta smelt, steelhead trout, splittail, and chinook salmon; and
- **ecological processes** (e.g., reducing losses of juvenile fishes at water diversions will improve Bay/Delta and upstream food webs).

D. Compatibility with Non-Ecosystem Objectives

Fish Treadmill project results obtained for listed native fishes, species that can affect operation of large water diversions (e.g., by take limits), have direct and timely application for development, design, and operation of several large fish facilities integral to non-ecosystem related CALFED objectives like **water supply reliability**. These include the improvements to the Tracy Fish Facility, the Clifton Court Forebay fish screens, proposed fish screens at upstream diversion(s) for off-stream storage, and the CALFED Isolated Conveyance alternative.

V. TECHNICAL FEASIBILITY AND TIMING

The Fish Treadmill and the ongoing research program is the most appropriate and comprehensive approach to address questions relating to specific aspects of fish screen design, flow criteria, and operation. This cooperative project, with the versatile, fully operational Fish Treadmill apparatus, highly qualified staff, and associated fish collection and maintenance facilities, is the only large scale fish screen test program capable of testing delicate, high priority native species like delta smelt under wide ranges of realistic, controlled flow and environmental conditions. The project will produce the detailed quantitative data necessary for development of fish screen criteria that protect native priority fishes of the Sacramento-San Joaquin watershed. There are no alternatives presently available or in place to meet the stated objectives.

This project will occur in a laboratory setting and requires no CEQA, NEPA, or other environmental compliance documents. Permits required to continue this project (e.g., DFG/IEP collection permit, water discharge permits, and UCD animal care protocols) are approved or have been submitted. A detailed Quality Assurance Project Plan has been approved. No zoning regulations, planning ordinances or other constraints that could impact the schedule and implementability of the project are known.

VI. MONITORING AND DATA COLLECTION

A. Biological/Ecological Objectives

The objectives of the Fish Treadmill project are to: quantitatively evaluate the performance (e.g., survival, frequency of contact with the fish screen, stress) and behavior (e.g., swimming velocity, rheotaxis, velocity past screen) of small-size, priority fish species exposed to controlled, multi-vector flows near a fish screen; compare the responses among species and environmental conditions; and interpret the data to determine protective fish screen design, flow, and operational criteria. For each species, size class and environmental condition, determination of optimal screen criteria will be based on comparisons of measured parameters among the different flow regimes. For example, optimal approach velocity may be that at which the frequency of screen contact is minimized, or optimal sweeping velocity may be that at which screen passage velocity is highest and thus screen exposure duration is minimized. Results will also be compared with all available fish performance and fish screen data (e.g., Kano, 1982; results from TFF, GCID, RBDD; other literature). Recommendations for specific screen criteria (e.g., approach velocity, maximum allowable exposure duration) and protection objectives (e.g., desired level of protection, maximum allowable predicted screen contact number) will be made in collaboration with our Interagency partners.

B. Monitoring Parameters/Experimental Variables and Data Evaluation Approach

The experimental design, methods and data evaluation approach of the Fish Treadmill project are complicated with many experimental variables and many measurements made during each experiment. Therefore, the table format suggested by the CALFED PSP has been modified to better present the required information. The experimental variables and monitoring parameters are outlined in Table 1 and the data collection and data evaluation approach in Table 2 (following pages). During the period for which funding is requested, we will conduct experiments with delta smelt (juveniles and adults), steelhead trout (parr), splittail (young-of-the-year), and chinook salmon (parr and smolts). If time, fish availability and funding permit, we will also test other priority species (e.g., longfin smelt) and American shad (to compare with Kano, 1982). The schedule of experiments for each species is determined by species priority rank, seasonal availability, and the numbers and types of experiments required to complete experimental datasets defined in the Fish Treadmill experimental design and project plan.

Table 1. Experimental variables and monitoring parameters used in the Fish Treadmill experiments.

| | | |
|--|--|--|
| FLOW (ft/s) (10 flow treatments, one control and nine experimental) | <i>Approach</i> | <i>Sweeping</i> |
| | 0 (control) | 0 (control) |
| | 0.2 (6 cm/s) | 0 |
| | 0.33 (10cm/s) | 0 |
| | 0.5 (15 cm/s) | 0 |
| | 0.2 | 1.0 (31cm/s) |
| | 0.33 | 1.0 |
| | 0.5 | 1.0 |
| | 0.2 | 2.0 (62 cm/s) |
| | 0.33 | 2.0 |
| | 0.5 | 2.0 |
| TEMPERATURE | 12°C: winter and spring 19°C: summer and fall | |
| TIME OF DAY/ LIGHT LEVEL | Day, light level: 200-300 lux Night, light level: 0-1 lux | |
| FISH SIZE | small: <6.0 cm SL medium: 6.0-8.0 cm SL | |
| NUMBER OF FISH PER EXPERIMENT | 20 fish | (All fish used only one time in the Fish Treadmill experiments.) |
| EXPERIMENT DURATION | 2 hours | |
| POST-EXPERIMENTAL EVALUATION | 48 hours | (Some fish sampled for stress responses during the post-experimental period.) |
| REPLICATES PER TREATMENT | 3 replicates | |

Table 2. Measurements made during each Fish Treadmill experiment.

| <i>Measurement type</i> | <i>Definition</i> | <i>Method</i> |
|--|---|---|
| FLOW and ENVIRONMENTAL CONDITIONS | | |
| Approach and Sweeping velocity | ft/s and cm/s | 3-D acoustic doppler velocimeter, Measured at beginning and end of each experiment |
| Temperature | °C | Measured at beginning and end of each experiment |
| Dissolved oxygen | mg/l | Measured at beginning and end of each experiment |
| Light level | lux | Measured at beginning of each experiment |
| PERFORMANCE | | |
| Impingement | prolonged (>5 min) contact with screen | measured visually throughout experiment |
| Screen contact | temporary contact with screen | measured visually throughout experiment |
| Survival | ----- | measured at 0 and 48 h post-experimental |
| Injury | damage to skin, scales, fins, eyes | measured 48 h post-experimental |
| BEHAVIOR | | |
| Swimming velocity | | |
| over the ground | cm/s, velocity past screen | measured using computer-assisted motion analysis of video tapes |
| through the water | cm/s, swimming velocity | |
| Orientation (rheotaxis) | orientation relative to resultant current | |
| Distance from screen | distance (cm) from inner fish screen | |
| Schooling | distribution of fish in swimming channel | measured visually throughout experiment |
| PHYSIOLOGICAL RESPONSES | | |
| Hematocrit (% red blood cells) | | |
| Plasma variables | | |
| pH | | Measured from pooled blood samples collected from two randomly selected fish at selected post-experimental times |
| lactate concentration | | |
| glucose concentration | | |
| chloride ion concentration (or osmolality) | | |
| cortisol concentration | | |

C. Peer-review, Reports, and Publications

Quarterly reports will include financial status, activities during the quarter, tasks completed, deliverables produced, problems encountered, and a description of modifications to the contract. Status and results of the project will also be presented and discussed at quarterly meetings of the Interagency partners, UCD research staff, outside consultants, and other interested parties. The final technical written report will be submitted by November 1, 2000. Results of these studies will also be described in IEP Newsletter articles, and in manuscripts submitted for publication in peer-reviewed scientific journals (e.g., Transactions of the American Fisheries Society, North American Journal of Fishery Management, Environmental Biology of Fishes, Copeia, Journal of Experimental Biology, Conservation Biology, Hydrobiologia, and Water Research). All data will be stored by the Principal Investigator for five years after project completion.

VII. LOCAL INVOLVEMENT

The Fish Treadmill project is an ongoing University-based, laboratory program. All required notifications and approvals (e.g., water discharge permit) to UCD, local governments, landowners, environmental groups, and other interested organizations are in place. Public outreach to interested parties (including academics, state and federal agency personnel, local and state media, and the general public) is accomplished through scheduled quarterly meetings, IEP Newsletter articles, journal articles in the scientific and technical press, and related UCD press releases.

VIII. COST

A. Budget

A total of \$1,036,821 (calculated at 46% overhead) is requested from CALFED for a 13.5 month effort to complete Tasks 1, 2, 3, and project management. If CALFED funding is provided through a State agency, overhead costs are reduced from 46% to 10% and total costs are \$823,000.

Task 1. Fish Treadmill Operation, Maintenance, and Calibration: The success of the project depends heavily on the proper function of the experimental apparatus, the Fish Treadmill. The UCD Hydraulics Engineering Group is responsible for this activity that includes: operation of the Fish Treadmill during all experiments; maintenance and repair of the Fish Treadmill; regular change of underground sump water; temperature control of sump water; maintenance and oversight of sump water quality (e.g. dissolved oxygen, ammonia, pH, alkalinity, and hardness); regular calibration of approach and sweeping flow combinations in the Fish Treadmill swimming channel; and report writing and presentation of results. Operation of the Fish Treadmill during experiments demands simultaneous and continuous adjustments by two engineers of incoming flow and discharge, water depth in the swimming channel, and the speed of the rotating outer screen. At least four part-time engineers are needed to ensure normal operation of the Fish Treadmill for two shifts each day. Additionally, they are also responsible for monitoring water quality before, during, and after the experiments. Two part-time mechanical technicians are needed for regular maintenance and repair of the Fish Treadmill.

Task 2. Biological Experiments: Biological studies using the Fish Treadmill are the responsibility of the UCD Fish Physiology Group. Personnel from DFG and DWR participate in some aspects of this task. This task includes: fish care and management; maintenance of fish and holding tank water quality; preparation for and implementation of experiments; post-experiment fish health and water quality; data entry; data analyses; interpretation of results; report writing; and presentation of results. Each experiment requires three to five researchers (depending on experimental flow and time of day, i.e., day vs night) for preparation, implementation, and immediate post-experiment activities. Each experiment also requires approximately four hours of motion analyses for fish behavior measurements, three hours of data entry and data quality assurance record keeping. The continuing project also requires two new 2-hp chillers for proper temperature control in fish holding facilities.

Task 3: Fish Collection: Fish field collection (for delta smelt and, if tested, longfin smelt) is primarily the responsibility of the DFG, in collaboration with the UCD Fish Physiology Group. This task includes: determining collection site locations based on DFG field monitoring data; scheduling collection expeditions; operation and maintenance of fishing boat and collection gear; and transport of collected fish to the UCD fish holding facilities. Each fish collection expedition for delta smelt involves at least four people to operate the boat, check Delta water condition, set and pull the purse seine, collect the fish, and transport the fish to UCD. Each fish collection takes approximately two hours boat and net preparation, two hours actual fish collection, two hours post-collection clean-up, and two hours post-transport fish care. Note that, in addition to this task, DFG personnel also participate in Task 2, biological studies using the Fish Treadmill.

Project Management: Project management will be conducted by the Principal Investigator, J. J. Cech, Jr. (UCD, Biological studies, Task 2), co-principal investigator M. L. Kavvas (UCD, Fish Treadmill operation, Task 1) and R. Fujimura (DFG, liaison and field fish collection, Task 3).

B. Schedule

Tasks 1 and 2 are interdependent and will take place concurrently throughout the 13.5 month period for which funding is requested. Activities in Task 3, fish collection, will be concentrated during the delta smelt collection season, August 1999-December 1999.

Table 3. Cost Breakdown of Funding Requested from the CALFED Program

| Task | Labor hours | Salaries & Benefits | Supplies & Expenses | Equipment | Student Fee Remissions | Travel | Publications | Indirect Cost @46% (@10%) | Sub-contract | Total Cost |
|---------------------------------|-------------|---------------------|---------------------|-------------|------------------------|-------------|--------------|---------------------------|--------------|---------------------|
| 1 | 10,578 | 239,929 | 11,568 | 0 | 9,414 | 0 | 0 | 115,689 (25,150) | 0 | 376,600 (286,061) |
| 2 | 13,892 | 295,447 | 30,000 | 10,000 | 4,725 | 10,000 | 6,000 | 157,066 (34,145) | 0 | 513,238 (390,317) |
| 3 | See Table 4 | See Table 4 | See Table 4 | See Table 4 | See Table 4 | See Table 4 | See Table 4 | 2,500 and see Table 4 | 143,020 | 145,520 |
| Project management task | 68 | 1,002 | 0 | 0 | 0 | 0 | 0 | 461 (100) | | 1,463 (1,102) |
| All (includes DFG sub-contract) | 33,448 | 649,526 | 46,948 | 12,000 | 14,139 | 10,400 | 6,000 | 275,716 (61,895) | | 1,036,821 (823,000) |

Table 4. Subcontract Funding for DFG (Task 3)

| Task | Labor hours | Salaries & Benefits | Supplies & Expenses | Equipment | Travel | Publications | Indirect Cost | Total Cost |
|------|-------------|---------------------|---------------------|-----------|--------|--------------|---------------|------------|
| 3 | 8,978 | 114,150 | 5,380 | 2,000 | 400 | 0 | 21,090 | 143,020 |

Table 5. Quarterly Budget for the Fish Treadmill Project. Budget figures are calculated with 46% overhead and 10% overhead (in parentheses).

| Task | Aug-Dec 99 | Jan-Mar 00 | Apr-Jun 00 | Jul-Sep 00 | Total Budget |
|--------------------|-------------------|------------------|------------------|------------------|-------------------|
| 1 | 125,523 (95,354) | 83,689 (63,569) | 83,689 (63,569) | 83,689 (63,569) | 376,600 (286,061) |
| 2 | 177,745 (136,772) | 111,831 (84,515) | 111,831 (84,515) | 111,831 (84,515) | 513,238 (390,317) |
| 3 | 49,006 | 31,338 | 31,338 | 31,338 | 143,020 |
| Project management | 488 (367) | 325 (245) | 325 (245) | 325 (245) | 1,463 (1,102) |

IX. COST-SHARING

To date, the Fish Treadmill project, including design, construction, modification, and calibration of the apparatus, upgrades to the UCD fish holding facilities, fish field collection, and all aspects of the hydraulic and biological studies conducted using the apparatus, has been funded exclusively by DWR. DWR has also provided funding to DFG to offset their costs for participation in the project (i.e., assistance with fish field collection and experimental data collection). For the period for which funding is requested from CALFED in this proposal, DWR has agreed to contribute funds to support at least one (1) full-time scientific aide (approximately \$20,000) to assist with Fish Treadmill project activities (e.g., fish collection and care, experimental set-up, data collection and preliminary analysis). In addition, UCD will contribute a percentage of two principal investigators' salaries (J. J. Cech, Jr., 5%, and M. L. Kavvas, 10%) plus benefits for a total of \$15,892. Thus, a total of \$35,892 is contributed as cost sharing, leveraged funds (Table 6).

Table 6. Total (including “leveraged”) funding for the project.

| SOURCE OF FUNDING | AMOUNT |
|--|--------------------------------|
| University of California, Davis (matching funds) | 15,892 |
| Department of Water Resources (personnel) | 20,000 |
| CALFED requested, @46% overhead (@10% overhead) | 1,036,821 (823,000) |
| Total | 1,072,713 (858,892) |

X. APPLICANT QUALIFICATIONS

A. Organization of Staff

The project will be under the direction and supervision of the principal investigator, Joseph J. Cech, Jr., Professor in the Department of Wildlife, Fish, and Conservation Biology, University of California, Davis (Task 2) and the co-principal investigator, Dr. M. L. Kavvas, Department of Civil and Environmental Engineering, University of California, Davis (Task 1). R. Fujimura (DFG) will provide additional management and support for fish collection (Task 3). Day to day project management, implementation, data analysis, interpretation and report writing will be provided by three post-doctoral researchers, co-investigators Drs. Christina Swanson and Paciencia S. Young (Task 2) and Dr. Z. Q. Chen (Task 1). Additional assistance with fish collection, fish care, fish management, experiment implementation, data collection, data entry, preliminary data analysis, and data quality control and assurance will be provided by full and part-time post-graduate researchers, student research assistants, and DFG and DWR researchers and scientific aides.

B. Collaborating Scientists (Biological Studies)

Dr. Joseph J. Cech, Jr. has been a professor at UCD since 1975 and was Chair of the Department of Wildlife, Fish, and Conservation Biology from 1992-1997. He has published more than 80 peer-reviewed articles in the fields of physiology and physiological ecology of fishes, and has won numerous awards, honors and grants. He has completed eight contracts with state agencies for studies of the physiological ecology of fishes of the Sacramento-San Joaquin system. He is presently co-principal investigator, with M. L. Kavvas (Department of Civil and Environmental Engineering, UCD) on the Fish Treadmill Project. Relevant publications include:

- Cech, J. J., Jr., Mitchell, S. J., Castleberry, D. T., and McEnroe, M. (1990) Distribution of California stream fishes: influence of environmental temperature and hypoxia. *Env. Biol. Fish.* 29:95-105.
- Moyle, P. B. and Cech, J. J., Jr. (1996) *Fishes: and introduction to ichthyology*. 3rd edition, Prentice Hall, Englewood Cliffs, New Jersey.
- Cech, J. J., Jr., Bartholow, S. D., Young, P. S., and Hopkins, T. E. (1996) Striped bass exercise and handling stress in fresh water: physiological responses to recovery environment. *Trans. Am. Fish. Soc.* 125:308-320.

Dr. Christina Swanson has been a post-doctoral researcher in Dr. Cech's laboratory for the past seven years, working on environmental tolerances, physiology, swimming performance, and behavior of Delta and upstream fishes, with an emphasis on the biology of delta smelt. She was the managing researcher on three successfully completed state contracts and is presently one of the managing biologists on the Fish Treadmill Project. Relevant recent publications include:

- Swanson, C., P. S. Young, and J. J. Cech, Jr. (1998) Swimming performance of delta smelt: maximum performance, and behavioral and kinematic limitations on swimming at submaximal velocities. *J. Exp. Biol.* 201:333-345.
- Swanson, C., T. Reid, P. S. Young, and J. J. Cech, Jr. (1999) Comparative environmental tolerances of threatened delta smelt (*Hypomesus transpacificus*) and introduced wakasagi (*H. nipponensis*) in an altered California estuary. (submitted, manuscript available on request)
- Swanson, C., P. S. Young, and J. J. Cech, Jr. (1998) Performance, behavior, and physiological responses of Delta fishes in two-vector flows in a fish treadmill. Part 3. Biological studies using the fish treadmill. Final Report, California Department of Water Resources. 59 pp.

Dr. Paciencia S. Young received her doctoral training and is presently a post-doctoral research in Dr. Cech's laboratory. She is an expert in the areas of stress and exercise physiology of fishes and has spent the past five years studying the environmental tolerances, swimming performance, and behavior of Delta fishes, with an emphasis on splittail and delta smelt. She was the managing researcher on three successfully completed state contracts and is presently one of the managing biologists on the Fish Treadmill project. Recent relevant publications include:

- Young, P. S., C. Swanson, and J. J. Cech, Jr. (1998) Performance, behavior, and physiological responses of Delta fishes in two-vector flows in a fish treadmill. Part 2. Illumination and photophase effects on swimming performance and behavior of Delta fishes. Final Report, California Department of Water Resources. 57 pp.
- Young, P. S. and J. J. Cech, Jr. (1996) Environmental tolerances and requirements of splittail. Trans. Am. Fish. Soc. 125:664-678.
- Young, P. S. and J. J. Cech, Jr. (1995) Environmental requirements and tolerances of Sacramento splittail, *Pogonichthys macrolepidotus* (Ayres). Final Report to the Interagency Ecological Studies Program for the San Francisco Bay/Delta. 56 pp.
- Young, P. S. and J. J. Cech, Jr. (1993) Effects of exercise conditioning on stress responses and recovery in cultured and wild young-of-the-year striped bass (*Morone saxatilis*). Can. J. Fish. Aquat. Sci. 50:2094-2099.

Dr. M. Levent Kavvas has been a professor in the Department of Civil and Environmental Engineering since 1985 and Director of the UCD Hydraulics Laboratory since 1991. He is the author of more than 75 journal and proceedings publications in the areas of hydraulic and hydrologic engineering. His areas of specialization include: physical hydraulic modeling of environmental fluid flows, pollutant and sediment transport, and modeling of hydrologic processes such as overland flow, erosion, and infiltration. He is presently principal investigator in the Fish Treadmill project. A recent relevant publications is:

- Velagic, E., M. L. Kavvas, W. Summer, and others (1996) Fish Screen test apparatus with variable two-vector flow conditions: hydraulic model. Final Report for California Department of Water Resources contract B-58719.

Dr. Z.Q. Chen is a Research Engineer and the manager of the UCD Hydraulics Laboratory. He has worked on various hydraulic modeling studies for more than ten years, and currently is the lead hydraulic engineer for the Fish Treadmill Project. Dr. Chen specializes in physical hydraulic models, hydraulic engineering, and hydrological modeling. A recent relevant publication is:

- Chen, Z. Q., E. Velagic, A. Karakas, E. Dogrul, H. Bandeh, W. Summer, and M. L. Kavvas (1998) Performance, behavior, and physiological responses of Delta fishes in two-vector flows in a fish treadmill. Part 1. Hydraulics Studies. Final Report, California Department of Water Resources. 42 pp.

Robert Fujimura is a biologist with the Bay/Delta division of DFG and has been working with the Fish Treadmill project since the initiation of biological studies using the apparatus. He will serve as primary Interagency liaison for fish collection, and assist the UCD staff in experimental design, implementation, and data analysis, and data quality control and assurance for the Fish Treadmill experiments.

XI. REFERENCES

- Kano, R. M. (1982) Responses of juvenile chinook salmon, *Oncorhynchus tshawytscha*, and American shad, *Alosa sapidissima*, to long term exposure to two-vector velocity flows. Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary, Technical Report 4. 20 pp.
- Swanson, C. and J. J. Cech, Jr. (1995) Environmental tolerances and requirements of the delta smelt, *Hypomesus transpacificus*. Final Report, California Department of Water Resources. 71 pp.
- Swanson, C., R. Mager, S. I. Doroshov, and J. J. Cech, Jr. (1996) Use of salts, anesthetics, and polymers to minimize handling and transport mortality in delta smelt. Transactions of the American Fisheries Society 125:326-329.
- Swanson, C., P. S. Young, and J. J. Cech, Jr. (1998a) Performance, behavior, and physiological responses of Delta fishes in two-vector flows in a fish treadmill. Part 3. Biological studies using the fish treadmill. Final Report, California Department of Water Resources. 59 pp.
- Swanson, C., P. S. Young, and J. J. Cech, Jr. (1998b) Performance, behavior, and physiological responses of Delta fishes in two-vector flows in a fish treadmill. Part 4. Quality assurance project plan. Final Report, California Department of Water Resources. 160 pp.
- Swanson, C., P. S. Young, and J. J. Cech, Jr. (1998c) Swimming performance of delta smelt: maximum performance, and behavioral and kinematic limitations on swimming at submaximal velocities. Journal of Experimental Biology. 201:333-345
- Velagic, E., Z. Q. Chen, A. Karakas, E. Dogrul, H. Bandeh, W. Summer, M. L. Kavvas, C. Swanson, P. S. Young, and J. J. Cech, Jr. (1998) Performance, behavior and physiology of Delta fishes in variable two-vector flows. Progress Report, California Department of Water Resources, Contract B 80898. 93 pp.
- Young, P. S. and J. J. Cech, Jr. (1996) Environmental tolerances and requirements of splittail. Trans. Am. Fish Soc. 125:664-678.
- Young, P. S., C. Swanson, and J. J. Cech, Jr. (1998) Performance, behavior, and physiological responses of Delta fishes in two-vector flows in a fish treadmill. Part 2. Illumination and photophase effects on swimming performance and behavior of Delta fishes. Final Report, California Department of Water Resources. 57 pp.

APPLICATION FOR FEDERAL ASSISTANCE

OMB Approval No. 0348-0043

| | | | | | |
|--|--|---|--|------------------------------|--|
| TYPE OF SUBMISSION: Application <input type="checkbox"/> Construction <input checked="" type="checkbox"/> Non-Construction | | 2. DATE SUBMITTED 4/16/99 | | Applicant Identifier | |
| | | 3. DATE RECEIVED BY STATE | | State Application Identifier | |
| Preapplication <input type="checkbox"/> Construction <input type="checkbox"/> Non-Construction | | 4. DATE RECEIVED BY FEDERAL AGENCY | | Federal Identifier | |

| | | | |
|---|----------------------------|--|---------------------------------------|
| APPLICANT INFORMATION Legal Name: Joseph J. Cech, Jr. | | Organizational Unit: University of California, Davis | |
| Address (give city, county, State, and zip code): Wildlife, Fish, & Conservation Biology University of California Davis, Yolo County, CA 95616 | | Name and telephone number of person to be contacted on matters involving this application (give area code): Joseph J. Cech, Jr. (530) 752-3103 jjcech@ucdavis.edu | |
| EMPLOYER IDENTIFICATION NUMBER (EIN): <div style="border: 1px solid black; padding: 2px; display: inline-block;"> 94 - 6036494 </div> | | 7. TYPE OF APPLICANT: (enter appropriate letter in box) <div style="display: flex; justify-content: space-between;"> <div style="width: 48%;"> A. State B. County C. Municipal D. Township E. Interstate F. Intermunicipal G. Special District </div> <div style="width: 48%;"> H. Independent School Dist. I. State Controlled Institution of Higher Learning J. Private University K. Indian Tribe L. Individual M. Profit Organization N. Other (Specify) _____ </div> </div> | |
| TYPE OF APPLICATION: <input checked="" type="checkbox"/> New <input type="checkbox"/> Continuation <input type="checkbox"/> Revision Revision, enter appropriate letter(s) in box(es) <input type="checkbox"/> <input type="checkbox"/> A. Increase Award B. Decrease Award C. Increase Duration D. Decrease Duration Other(specify): _____ | | 9. NAME OF FEDERAL AGENCY: US Bureau of Reclamation | |
| 3. CATALOG OF FEDERAL DOMESTIC ASSISTANCE NUMBER: <div style="border: 1px solid black; padding: 2px; display: inline-block;"> 00 - 0000 </div> | | 11. DESCRIPTIVE TITLE OF APPLICANT'S PROJECT: Fish Treadmill-Developed Fish Screen Criteria for Native Sacramento-San Joaquin Fishes. | |
| 2. AREAS AFFECTED BY PROJECT (Cities, Counties, States, etc.): Yolo County, State of California, USA | | | |
| 3. PROPOSED PROJECT | | 14. CONGRESSIONAL DISTRICTS OF: | |
| Start Date 8/16/99 | Ending Date 9/30/00 | a. Applicant Congressional Distr. #3 | |
| 5. ESTIMATED FUNDING: | | b. Project Congressional Distr. #3 | |
| Federal | \$ 1,036,821 (13.5 months) | 16. IS APPLICATION SUBJECT TO REVIEW BY STATE EXECUTIVE ORDER 12372 PROCESS? | |
| Applicant | \$ | a. YES. THIS PREAPPLICATION/APPLICATION WAS MADE AVAILABLE TO THE STATE EXECUTIVE ORDER 12372 PROCESS FOR REVIEW ON: DATE _____ | |
| State | \$ | b. No. <input type="checkbox"/> PROGRAM IS NOT COVERED BY E. O. 12372 <input type="checkbox"/> OR PROGRAM HAS NOT BEEN SELECTED BY STATE FOR REVIEW | |
| Local | \$ | 17. IS THE APPLICANT DELINQUENT ON ANY FEDERAL DEBT? | |
| Other | \$ | <input type="checkbox"/> Yes If "Yes," attach an explanation. <input checked="" type="checkbox"/> No | |
| Program Income | \$ | | |
| TOTAL | \$ 1,036,821 (13.5 months) | | |
| 8. TO THE BEST OF MY KNOWLEDGE AND BELIEF, ALL DATA IN THIS APPLICATION/PREAPPLICATION ARE TRUE AND CORRECT, THE DOCUMENT HAS BEEN DULY AUTHORIZED BY THE GOVERNING BODY OF THE APPLICANT AND THE APPLICANT WILL COMPLY WITH THE ATTACHED ASSURANCES IF THE ASSISTANCE IS AWARDED. | | | |
| Type Name of Authorized Representative | | b. Title Fay Yee Contracts & Grants Analyst | c. Telephone Number (530) 752-2075 |
| Signature of Authorized Representative | | e. Date Signed | |

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U.S. Department of the Interior

Certifications Regarding Debarment, Suspension and
Other Responsibility Matters, Drug-Free Workplace
Requirements and Lobbying

Persons signing this form should refer to the regulations referenced below for complete instructions:

Certification Regarding Debarment, Suspension, and Other Responsibility Matters - Primary Covered Transactions - The prospective primary participant further agrees by submitting this proposal that it will include the clause titled, "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion - Lower Tier Covered Transaction," provided by the department or agency entering into this covered transaction, without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions. See below for language to be used; use this form for certification and sign; or use Department of the Interior Form 1954 (DI-1954). (See Appendix A of Subpart D of 43 CFR Part 12.)

Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion - Lower Tier Covered Transactions - (See Appendix B of Subpart D of 43 CFR Part 12.)

Certification Regarding Drug-Free Workplace Requirements - Alternate I. (Grantees Other Than Individuals) and Alternate II. (Grantees Who are Individuals) - (See Appendix C of Subpart D of 43 CFR Part 12)

Signature on this form provides for compliance with certification requirements under 43 CFR Parts 12 and 18. The certifications shall be treated as a material representation of fact upon which reliance will be placed when the Department of the Interior determines to award the covered transaction, grant, cooperative agreement or loan.

PART A: Certification Regarding Debarment, Suspension, and Other Responsibility Matters - Primary Covered Transactions

CHECK ☐ IF THIS CERTIFICATION IS FOR A PRIMARY COVERED TRANSACTION AND IS APPLICABLE.

- (1) The prospective primary participant certifies to the best of its knowledge and belief, that it and its principals:
- (a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;
 - (b) Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;
 - (c) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph (1)(b) of this certification; and
 - (d) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State or local) terminated for cause or default.
- (2) Where the prospective primary participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

PART B: Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion - Lower Tier Covered Transactions

CHECK ☐ IF THIS CERTIFICATION IS FOR A LOWER TIER COVERED TRANSACTION AND IS APPLICABLE.

- (1) The prospective lower tier participant certifies, by submission of this proposal, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any Federal department or agency.
- (2) Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

DI-2010
March 1995
(This form consolidates DI-1953, DI-1954,
DI-1955, DI-1956 and DI-1962)

PART C: Certification Regarding Drug-Free Workplace Requirements

CHECK ☐ IF THIS CERTIFICATION IS FOR AN APPLICANT WHO IS NOT AN INDIVIDUAL

Alternate I. (Grantees Other Than Individuals)

A. The grantee certifies that it will or continue to provide a drug-free workplace by:

- (a) Publishing a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the grantee's workplace and specifying the actions that will be taken against employees for violation of such prohibition;
- (b) Establishing an ongoing drug-free awareness program to inform employees about—
 - (1) The dangers of drug abuse in the workplace;
 - (2) The grantee's policy of maintaining a drug-free workplace;
 - (3) Any available drug counseling, rehabilitation, and employee assistance programs; and
 - (4) The penalties that may be imposed upon employees for drug abuse violations occurring in the workplace;
- (c) Making it a requirement that each employee to be engaged in the performance of the grant be given a copy of the statement required by paragraph (a);
- (d) Notifying the employee in the statement required by paragraph (a) that, as a condition of employment under the grant, the employee will —
 - (1) Abide by the terms of the statement; and
 - (2) Notify the employer in writing of his or her conviction for a violation of a criminal drug statute occurring in the workplace no later than five calendar days after such conviction;
- (e) Notifying the agency in writing, within ten calendar days after receiving notice under subparagraph (d)(2) from an employee or otherwise receiving actual notice of such conviction. Employers of convicted employees must provide notice, including position title, to every grant officer on whose grant activity the convicted employee was working, unless the Federal agency has designated a central point for the receipt of such notices. Notice shall include the identification numbers(s) of each affected grant;
- (f) Taking one of the following actions, within 30 calendar days of receiving notice under subparagraph (d)(2), with respect to any employee who is so convicted —
 - (1) Taking appropriate personnel action against such an employee, up to and including termination, consistent with the requirements of the Rehabilitation Act of 1973, as amended; or
 - (2) Requiring such employee to participate satisfactorily in a drug abuse assistance or rehabilitation program approved for such purposes by a Federal, State, or local health, law enforcement, or other appropriate agency;
- (g) Making a good faith effort to continue to maintain a drug-free workplace through implementation of paragraphs (a) (b), (c), (d), (e) and (f).

B. The grantee may insert in the space provided below the site(s) for the performance of work done in connection with the specific grant:

Place of Performance (Street address, city, county, state, zip code)

Department of Wildlife, Fish, & Conservation Biology, University of
California, One Shields Ave., Davis, CA 95616

Check ☐ if there are workplaces on file that are not identified here.

PART D: Certification Regarding Drug-Free Workplace Requirements

CHECK ☐ IF THIS CERTIFICATION IS FOR AN APPLICANT WHO IS AN INDIVIDUAL

Alternate II. (Grantees Who Are Individuals)

- (a) The grantee certifies that, as a condition of the grant, he or she will not engage in the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance in conducting any activity with the grant;
- (b) If convicted of a criminal drug offense resulting from a violation occurring during the conduct of any grant activity, he or she will report the conviction, in writing, within 10 calendar days of the conviction, to the grant officer or other designee, unless the Federal agency designates a central point for the receipt of such notices. When notice is made to such a central point, it shall include the identification number(s) of each affected grant.

PART E: Certification Regarding Lobbying
Certification for Contracts, Grants, Loans, and Cooperative Agreements

CHECK IF CERTIFICATION IS FOR THE AWARD OF ANY OF THE FOLLOWING AND THE AMOUNT EXCEEDS \$100,000: A FEDERAL GRANT OR COOPERATIVE AGREEMENT; SUBCONTRACT, OR SUBGRANT UNDER THE GRANT OR COOPERATIVE AGREEMENT.

CHECK IF CERTIFICATION IS FOR THE AWARD OF A FEDERAL LOAN EXCEEDING THE AMOUNT OF \$150,000, OR A SUBGRANT OR SUBCONTRACT EXCEEDING \$100,000, UNDER THE LOAN.

The undersigned certifies, to the best of his or her knowledge and belief, that:

- (1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, and officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.
- (2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.
- (3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by Section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

As the authorized certifying official, I hereby certify that the above specified certifications are true.


SIGNATURE OF AUTHORIZED CERTIFYING OFFICIAL

TYPED NAME AND TITLE

Fay Yee
Contracts & Grants Analyst

DATE

4/16/95

ASSURANCES - NON-CONSTRUCTION PROGRAMS

Public reporting burden for this collection of information is estimated to average 15 minutes per response, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding the burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to the Office of Management and Budget, Paperwork Reduction Project (0348-0040), Washington, DC 20503.

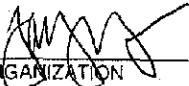
PLEASE DO NOT RETURN YOUR COMPLETED FORM TO THE OFFICE OF MANAGEMENT AND BUDGET. SEND IT TO THE ADDRESS PROVIDED BY THE SPONSORING AGENCY.

NOTE: Certain of these assurances may not be applicable to your project or program. If you have questions, please contact the awarding agency. Further, certain Federal awarding agencies may require applicants to certify to additional assurances. If such is the case, you will be notified.

As the duly authorized representative of the applicant, I certify that the applicant:

1. Has the legal authority to apply for Federal assistance and the institutional, managerial and financial capability (including funds sufficient to pay the non-Federal share of project cost) to ensure proper planning, management and completion of the project described in this application.
2. Will give the awarding agency, the Comptroller General of the United States and, if appropriate, the State, through any authorized representative, access to and the right to examine all records, books, papers, or documents related to the award; and will establish a proper accounting system in accordance with generally accepted accounting standards or agency directives.
3. Will establish safeguards to prohibit employees from using their positions for a purpose that constitutes or presents the appearance of personal or organizational conflict of interest, or personal gain.
4. Will initiate and complete the work within the applicable time frame after receipt of approval of the awarding agency.
5. Will comply with the Intergovernmental Personnel Act of 1970 (42 U.S.C. §§4728-4763) relating to prescribed standards for merit systems for programs funded under one of the 19 statutes or regulations specified in Appendix A of OPM's Standards for a Merit System of Personnel Administration (5 C.F.R. 900, Subpart F).
6. Will comply with all Federal statutes relating to nondiscrimination. These include but are not limited to: (a) Title VI of the Civil Rights Act of 1964 (P.L. 88-352) which prohibits discrimination on the basis of race, color or national origin; (b) Title IX of the Education Amendments of 1972, as amended (20 U.S.C. §§1681-1683, and 1685-1686), which prohibits discrimination on the basis of sex; (c) Section 504 of the Rehabilitation Act of 1973, as amended (29 U.S.C. §794), which prohibits discrimination on the basis of handicaps; (d) the Age Discrimination Act of 1975, as amended (42 U.S.C. §§6101-6107), which prohibits discrimination on the basis of age; (e) the Drug Abuse Office and Treatment Act of 1972 (P.L. 92-255), as amended, relating to nondiscrimination on the basis of drug abuse; (f) the Comprehensive Alcohol Abuse and Alcoholism Prevention, Treatment and Rehabilitation Act of 1970 (P.L. 91-616), as amended, relating to nondiscrimination on the basis of alcohol abuse or alcoholism; (g) §§523 and 527 of the Public Health Service Act of 1912 (42 U.S.C. §§290 dd-3 and 290 ee 3), as amended, relating to confidentiality of alcohol and drug abuse patient records; (h) Title VIII of the Civil Rights Act of 1968 (42 U.S.C. §§3601, et seq.), as amended, relating to nondiscrimination in the sale, rental or financing of housing; (i) any other nondiscrimination provisions in the specific statute(s) under which application for Federal assistance is being made; and, (j) the requirements of any other nondiscrimination statute(s) which may apply to the application.
7. Will comply, or has already complied, with the requirements of Titles II and III of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (P.L. 91-646) which provide for fair and equitable treatment of persons displaced or whose property is acquired as a result of Federal or federally-assisted programs. These requirements apply to all interests in real property acquired for project purposes regardless of Federal participation in purchases.
8. Will comply, as applicable, with provisions of the Hatch Act (5 U.S.C. §§1501-1508 and 7324-7328) which limit the political activities of employees whose principal employment activities are funded in whole or in part with Federal funds.

9. Will comply, as applicable, with the provisions of the Davis-Bacon Act (40 U.S.C. §§276a to 276a-7), the Copeland Act (40 U.S.C. §276c and 18 U.S.C. §874), and the Contract Work Hours and Safety Standards Act (40 U.S.C. §§327-333), regarding labor standards for federally-assisted construction subagreements.
10. Will comply, if applicable, with flood insurance purchase requirements of Section 102(a) of the Flood Disaster Protection Act of 1973 (P.L. 93-234) which requires recipients in a special flood hazard area to participate in the program and to purchase flood insurance if the total cost of insurable construction and acquisition is \$10,000 or more.
11. Will comply with environmental standards which may be prescribed pursuant to the following: (a) institution of environmental quality control measures under the National Environmental Policy Act of 1969 (P.L. 91-190) and Executive Order (EO) 11514; (b) notification of violating facilities pursuant to EO 11738; (c) protection of wetlands pursuant to EO 11990; (d) evaluation of flood hazards in floodplains in accordance with EO 11988; (e) assurance of project consistency with the approved State management program developed under the Coastal Zone Management Act of 1972 (16 U.S.C. §§1451 et seq.); (f) conformity of Federal actions to State (Clean Air) Implementation Plans under Section 176(c) of the Clean Air Act of 1955, as amended (42 U.S.C. §§7401 et seq.); (g) protection of underground sources of drinking water under the Safe Drinking Water Act of 1974, as amended (P.L. 93-523); and, (h) protection of endangered species under the Endangered Species Act of 1973, as amended (P.L. 93-205).
12. Will comply with the Wild and Scenic Rivers Act of 1968 (16 U.S.C. §§1271 et seq.) related to protecting components or potential components of the national wild and scenic rivers system.
13. Will assist the awarding agency in assuring compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (16 U.S.C. §470), EO 11593 (identification and protection of historic properties), and the Archaeological and Historic Preservation Act of 1974 (16 U.S.C. §§469a-1 et seq.).
14. Will comply with P.L. 93-348 regarding the protection of human subjects involved in research, development, and related activities supported by this award of assistance.
15. Will comply with the Laboratory Animal Welfare Act of 1966 (P.L. 89-544, as amended, 7 U.S.C. §§2131 et seq.) pertaining to the care, handling, and treatment of warm blooded animals held for research, teaching, or other activities supported by this award of assistance.
16. Will comply with the Lead-Based Paint Poisoning Prevention Act (42 U.S.C. §§4801 et seq.) which prohibits the use of lead-based paint in construction or rehabilitation of residence structures.
17. Will cause to be performed the required financial and compliance audits in accordance with the Single Audit Act Amendments of 1996 and OMB Circular No. A-133, "Audits of States, Local Governments, and Non-Profit Organizations."
18. Will comply with all applicable requirements of all other Federal laws, executive orders, regulations, and policies governing this program.

| | |
|--|--|
| SIGNATURE OF AUTHORIZED CERTIFYING OFFICIAL  | TITLE Fay Yee Contracts & Grants Analyst |
| APPLICANT ORGANIZATION THE REGENTS OF THE UNIVERSITY OF CALIFORNIA | DATE SUBMITTED 4/16/99 |

Standard Form 424B (Rev. 7-97) Bac

BUDGET INFORMATION - Non-Construction Programs**SECTION A - BUDGET SUMMARY**

| Grant Program Function or Activity (a) | Catalog of Federal Domestic Assistance Number (b) | Estimated Unobligated Funds | | New or Revised Budget | | |
|---|--|-----------------------------|--------------------|-----------------------|--------------------|--------------|
| | | Federal (c) | Non-Federal (d) | Federal (e) | Non-Federal (f) | Total (g) |
| 1. Task 1 UCD Hydraulics Lab | | \$ | \$ | \$376,600 | \$ | \$376,600 |
| 2. Task 2 UCD Fish Physiology | | | | 514,701 | | 514,701 |
| 3. CDFG | | | | 145,520 | | 145,520 |
| 4 | | | | | | |
| 5. Totals | | \$0 | \$0 | \$1,036,821 | \$0 | \$1,036,821 |

SECTION B - BUDGET CATEGORIES

| 6. Object Class Categories | GRANT PROGRAM, FUNCTION OR ACTIVITY | | | | Total (5) |
|--|-------------------------------------|-----------|-----------|-----|--------------|
| | (1) | (2) | (3) | (4) | |
| a. Personnel | \$205,071 | \$244,414 | \$98,930 | \$ | \$548,415 |
| b. Fringe Benefits | 34,858 | 52,496 | 15,220 | | 102,574 |
| c. Travel | 0 | 10,000 | 400 | | 10,400 |
| d. Equipment | 0 | 10,000 | 2,000 | | 12,000 |
| e. Supplies | 11,568 | 36,000 | 5,300 | | 52,868 |
| f. Contractual | 0 | 0 | 2,500 | | 2,500 |
| g. Construction | 0 | 0 | 0 | | 0 |
| h. Other | 9,414 | 4,725 | 0 | | 14,139 |
| i. Total Direct Charges (sum of 6a-6h) | 260,911 | 356,172 | 124,350 | | 741,433 |
| j. Indirect Charges | 115,684 | 157,066 | 21,090 | | 293,840 |
| k. TOTALS (sum of 6i and 6j) | \$376,600 | \$514,701 | \$145,520 | \$ | \$1,036,821 |
| 7. Program Income | \$0 | \$0 | \$0 | \$ | \$ |

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| SECTION C - NON-FEDERAL RESOURCES | | | | | |
|---|---------------------------------|-------------|-------------------|-------------|--|
| (a) Grant Program | (b) Applicant | (c) State | (d) Other Sources | (e) TOTALS | |
| 8. Task 1 UCD Hydraulic Lab | \$9,800 | \$0 | \$0 | \$9,800 | |
| 9. Task 2 UCD Fish Physiology | 6092 | 20,000 | 0 | 26,092 | |
| 10. Task 3 CDFG | 0 | 0 | 0 | 0 | |
| 11 | | | | | |
| 12. TOTAL (sum of lines 8-11) | \$15,892 | \$20,000 | \$0 | \$35,892 | |
| SECTION D - FORECASTED CASH NEEDS | | | | | |
| Total for 1st Year | 1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter | |
| 13. Federal | \$922,732 | \$238,183 | \$228,183 | \$228,183 | |
| 14. NonFederal | \$31,904 | \$7,976 | \$7,976 | \$7,976 | |
| 15. TOTAL (sum of lines 13 and 14) | 954,636 | 246,159 | 236,159 | 236,159 | |
| SECTION E - BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT | | | | | |
| (a) Grant Program | FUTURE FUNDING PERIODS (Years) | | | | |
| | (b) First | (c) Second | (d) Third | (e) Fourth | |
| 16 | \$114,089 | \$ | \$ | \$ | |
| 17 | 3,988 | | | | |
| 18 | | | | | |
| 19 | | | | | |
| 20. TOTAL (sum of lines 16-19) | \$118,077 | \$ | \$ | \$ | |
| SECTION F - OTHER BUDGET INFORMATION | | | | | |
| 21. Direct Charges: \$740,476 | 22. Indirect Charges: \$286,345 | | | | |
| 23. Remarks: | | | | | |

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Standard Form 424A (Rev. 4-92) Page 2

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SANTA BARBARA • SANTA CRUZ

COLLEGE OF AGRICULTURAL AND
ENVIRONMENTAL SCIENCES
AGRICULTURAL EXPERIMENT STATION
COOPERATIVE EXTENSION

DEPARTMENT OF WILDLIFE, FISH AND CONSERVATION BIOLOGY
ONE SHIELDS AVENUE
DAVIS, CALIFORNIA 95616-8751
FAX (530) 752-4154

April 14, 1999

Yolo County Board of Supervisors
625 Court
Woodland, CA 95695-3448

Dear Sir or Madam,

This letter to inform you that I have submitted a proposal entitled "Fish Treadmill-Developed Fish Screen Criteria for Native Sacramento-San Joaquin Watershed Fishes" to the CALFED Ecosystem Restoration Program. The work described in the proposal will be conducted at the University of California, Davis, in Yolo County.

Sincerely,

A handwritten signature in cursive script, appearing to read "Joseph J. Cech, Jr.", written in dark ink.

Joseph J. Cech, Jr.
Professor

cc: CALFED Bay/Delta Program

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DEPARTMENT OF WILDLIFE, FISH AND CONSERVATION BIOLOGY
ONE SHIELDS AVENUE
DAVIS, CALIFORNIA 95616-8751
FAX (530) 752-4154

April 14, 1999

Yolo County Planning Department
292 W. Beamer
Woodland, CA 95695

Dear Sir or Madam,

This letter to inform you that I have submitted a proposal entitled "Fish Treadmill-Developed Fish Screen Criteria for Native Sacramento-San Joaquin Watershed Fishes" to the CALFED Ecosystem Restoration Program. The work described in the proposal will be conducted at the University of California, Davis, in Yolo County.

Sincerely,

A handwritten signature in dark ink, appearing to read "Joseph J. Cech, Jr.", is written over the typed name.

Joseph J. Cech, Jr.
Professor

cc: CALFED Bay/Delta Program